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Socio-economic assessment of post-harvest loss of cauliflower in Bagmati Pradesh of Nepal

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ABSTRACT

Various types of post-harvest practice has different effect in maintaining physical appearance, acceptability and economic return for cauliflower. Kavre and Dhading two different districts with similar ecological zone was the study site. Household survey, KII and FGD was the tools used to collect the information about the farmer's perception and practices to minimize the post-harvest loss of the cauliflower. Study depicted harvesting at improper stage check the potential growth and quantity of each curd and is demand driven factor. Both early and late maturity of curd has bad effect in floret. 25% farmers reported they are in practice of harvest the cauliflower at improper stage for the sake of money and to maintain cropping pattern. Study shows lack of knowledge about the importance of Sorting, grading, washing because more labour and no incentive due to adding more value in the product were the pertinent factors for post-harvest loss. Only few farmers are practicing packaging practices and Bamboo basket or Polythene bag were used as packing material and medium size cauliflower on middle to hide. Traders prefer to use bamboo basket but farmers like polythene bags due to cost effectiveness. The size of packet is 20-40 kg. Though the farmers know about the local processing techniques like drying of slices or making pickle, but they do not practice this because there is no demand for this at local level and no demand from trader's side too. Post-harvest loss calculated was 10.9% of the total production. Cauliflower production in the year of 2016 was 550044.8Mt and in the year of 2019 it was 574795Mt. Total post-harvest loss in the year 2019 was 62652.66Mt. Average price of cauliflower was Rs28/Kg and the total value was Rs.1, 75, 42, 74,340. Therefore; awareness about the importance of post-harvest loss minimization practices and cold storage structure in the site was recommended to check the cauliflower import and promote fresh vegetables export.

Keywords: Cauliflower, post-harvest

1. INTRODUCTION

Post-harvest losses during handling, transportation, storage and distribution of vegetable commodities are the major problems of perishable vegetables. In addition of this due to poor handlings causes more loss and increases the supply cost due to increased transport and marketing cost (Subrahmanyam, 1986).

Among different vegetables Cauliflower (*Brassica oleracea* var. botrytis) is gaining popularity in Nepalese kitchen is a cash crop and the number one vegetable crop in terms of production and due to its high nutritive value in Nepal. The postharvest losses in fresh fruits and vegetables in Nepal have been estimated to be around 20-30%. However, In the case of cauliflower postharvest losses has been estimated only 10-15% (Adhikari, 2006).

Although the market price of a commodity is determined by the forces of supply and demand but in the case of cauliflower the quality and visual also plays an equal role. Quality of cauliflower curd comprises with compact, clean free from riciness and compact flowers, well-trimmed with an optimum number of leaves to protect the flower having with a 10 mm stem, free from cuts, no damage from insect and pest (FAO 2015). But it doesn't limit to the quality only; as report shows losses in vegetables are reported as result from harvesting at an improper stage of maturity, direct packing and shipping without the removal of field heat, improper packaging and insufficient grading and sorting, poor transportation, handling and poor storage facilities. Different technologies were developed about the post-harvest loss by different institution in the country. Therefore, exploration of the adoption status of this technology could help to develop scaling out strategies to increase return of farmer and indirectly boosts up the food security. This loss ultimately results the higher cost of production and reduce the profit margin of farmers making this sector a less lucrative enterprise in Nepal. Similarly, various postharvest management researches have been carried out by NARC since many years; but researches on socio economic perspective of postharvest technologies are inadequate to address the economic value of loss of cauliflower within different stages of different cauliflower stakeholders. The critical concerns for the cause of post-harvest losses at producer level were; damage during harvest, damaged due to diseases, damages due to insect, damage during transportation, lack of proper cleaning and washing showed a positive relationship between each independent variable and the dependent variable (Subrahmanyam, 1986). Therefore, this study aims to assess developed technologies and evaluate farmer's knowledge, perception, practices and incorporate the gender dynamics in use of postharvest technologies with following objectives. To assess the developed postharvest technology in Nepal and to measure the post-harvest loss and economic gain of adopted postharvest technology were the objectives to be addressed under this study.

2. METHODOLOGY

Two districts with almost similar ecological boundries Dhading and Banepa (Ward no 2, 3 and 4) were the two different sites selected for the study the reason behind it is the availability of the cauliflower growing farmers. The questionnaire was pre-tested and 50 different households were surveyed. Two focused group discussion (FGD) was done in each district. Two Key Informant Interview (KII) with Lead farmer and collector from Dhading and Banepa each were done. Secondary data was collected from literature and the desk review. Key informant interview was done from two local trader. Key informant interview with two local trader, retailer, vendors and from Dhading and Banepa. Key informant interview was done with five whole sale traders. Key informant interview was done with five wholesale and retail shop of Kalimati. Sampling frame was the farmers list provided by KOICA site office staff. Random sampling method was done.

3. RESULTS

This study addressed the type of post-harvest technologies exist in market. Evaluate the value chain actor's knowledge, perception and practices on post-harvest technologies incorporating gender issues and the way to minimize the loss.

Socioeconomic parameter of producer

Socio-economic parameter includes age, schooling, family size, male member, female member, active family members in agricultural activities, cultivated land and the size of cauliflower cultivated land of the producers. It shows the average age of the respondent was 40.68 with the family size of 4.96 where the gender balance was almost 50:50 with active 3.5person per house; where 0.11ha of area was occupied by cauliflower out of the total 0.27ha of land under cultivation (Table:1). Beside this farmer's land holding size was categorized by .1ha to .5ha, .5ha to 1ha and greater than 1ha and above where 82% of respondents bear only .1 to .5ha of the category which shows the large number of farmer's involvement in scattered land.

Table 1: Socio-economic parameter of the farmers

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	50	40.68	10.64	17	61
Schooling	50	5.58	4.50	0	15

Family size	50	4.96	1.74	1	10
Male	50	2.52	0.91	0	5
Female	49	2.49	1.23	1	6
Active	50	3.52	1.73	1	10
Total land (ha)	50	0.27	0.24	0	1.16
Cultivated land (ha)	50	0.27	0.24	0	1.16
Cauliflower cultivated (ha)	50	0.11	0.14	0	0.83

Similarly study site comprises with the 48% of Brahmin, 48% of the Janjati and 4% of Dalit.

Farmer's view on causes of post-harvest

Harvesting at improper stage check the potential growth and quantity of each curd and is demand driven factor. Both early and late maturity of curd has bad effect in floret. Table 2 depicted 25% farmers reported they could harvest at improper stage for the sake of money and to maintain cropping pattern.

Table 2: Farmer's perception on causes of loss

Parameter	Farmers	Cause
Harvesting at improper stage	25%	Demand driven
Seasonality matters	5%	All the cauliflower are matured at a time of many farmers
Direct packing	5% (Mostly small farmers)	Carelessness
Poor and rough handling during transportation	2%	farmers reluctance for ownership towards the product

Handling practices in farm

Farmers used bare hand and the sickle to harvest the cauliflower. So, there is not any assigned mechanism or technology to harvest the cauliflower. However, farmers felt comfort to harvest on crate a designed basket made up of plastic materials, but crate is difficult to carry in poor road condition and only commercial farmers that is >1 ha of land strictly follow the time of harvest and left on sunshine (Table 3).

Table 3: Difference in handling practices among the different categories of farmers

Categories of farmers Land holding size (ha)	Method of harvesting	Harvesting tool	Container used to harvest	Left for	Time of harvest
.1 to .5		a. Bare hands (20%) b. Sickle (80%)	Vary with the road doko/crate or	a.10 to 15 min b. 2hrs.	a. During sunshine b. During cloudy weather

.5 to 1		Sickles			
>1		Sickle and knife	Crate/plastic		Decision to harvest depends on the local traders and local weather situation.

Post-harvest handling operations

Traditional and improved two types of post-harvest handling operations are in practice. Harvesting at correct stage, sorting practice, Although the sorting of cauliflower is improved practice but 95% of respondents reported due to not any economic difference and consumer's preference cauliflower in farmer's level is not sorted. Trimming of stem 10cm to more with 6 to 20 leaves. (Vary with the price of cauliflower, if expensive more no of leaves).

Economic advantages of technology adoption

The cost of (doko) an indigenous technology is (Rs.500-800/piece) and the loss was (1-2kg). Whereas, the aggregator brings crate in house therefore it's easy, cheap (NRs.300) and more accessible. Very negligible amount of loss in crate was recorded. None of the farmers use any green leaves or any cousin material during transporting because farmers are less informative and have no idea about the merit and demerit.

Table 4: Traditional and improved post-harvest handling operations

Handling operations	Traditional operation	Improved practice	Existing practice
Harvesting	Harvesting at mixed stage of maturity	Harvesting at correct stage	Demand driven
Field sorting	No	Yes	No
Trimming	No or partial trimming	Trimming of stem to 1-2cm long with 4 wrapper leaves	Trimming of stem 10cm to more with 6 to 20 leaves. (Vary with the price of cauliflower, if expensive more no of leaves)
Packaging	Bulk packaging in 50Kg crate or plastic	Packing with 15kg	Vary with stage of production to marketing

Grading, Packaging and processing practices

The main basis of grading is appearance of inflorescence. Good, poor and the mixed were the three types of qualities of cauliflower. White color or insect free and tight inflorescence, get better price 30/kg was categorized with good quality. Black spot, bolted head and insect attack, Poor quality get price 20/kg Poor Quality. If the cauliflowers are not graded and found with mixed quality they fetch price of 28/Kg. But commonly they do not practice it because there is not significant price variation between good quality cauliflower and mixed quality. Study shows almost none and very less number of people are familiar with the importance of Sorting, grading, washing because more labour and no incentive due to adding more value in the product. Only few farmers are practicing packaging practices and Bamboo basket or Polythene bag were used as packing material and medium size cauliflower on middle to high. Traders prefer to use bamboo basket but farmers like polythene bags due to cost effectiveness. The size of packet is

20-40 kg. Though the farmers know about the local processing techniques like drying of slices or making pickle, but they do not practice this because there is no demand for this at local level and no demand from trader's side too.

Types of traders

Local farmers-Consumers, Local farmers-vendors, Local farmers-small shop, Farmers-Local Collector-Wholesale market-retailer, Farmers-supermarket were the type of traders exist in formal and informal way of marketing system.

Post-harvest loss of cauliflower on different stages of marketing

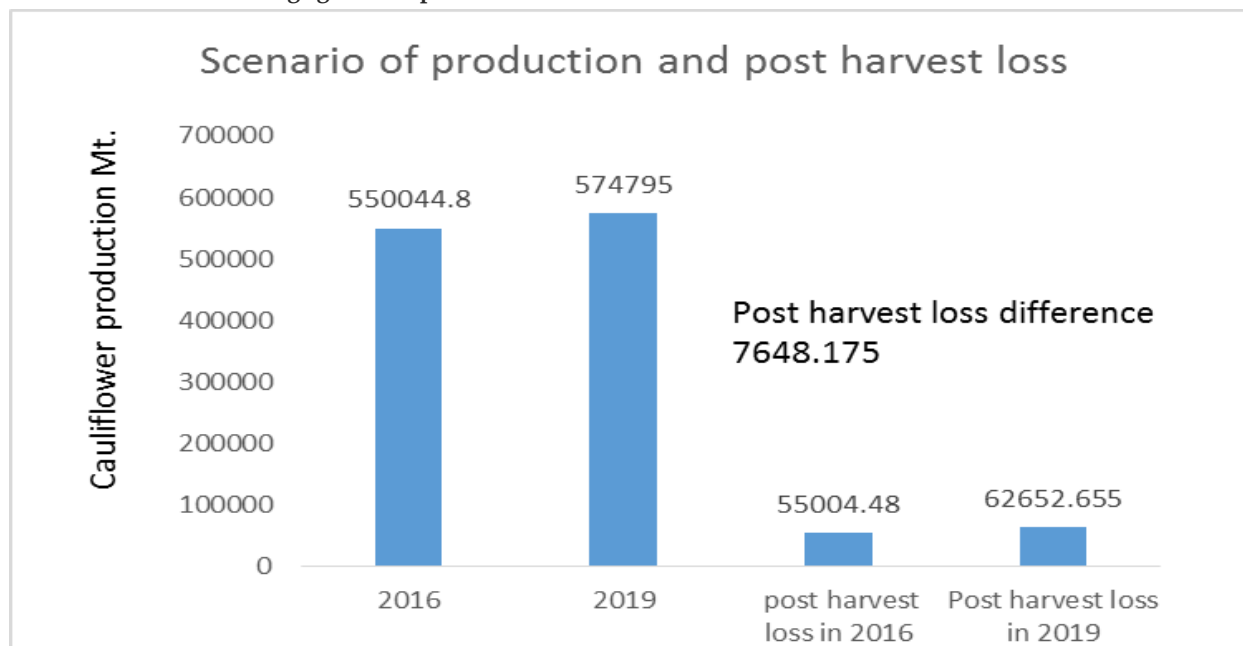
Production level, farmers to collector, collector to wholesaler, wholesaler to retailer, retailer-collector to processing unit were the different stages of supply chain of the cauliflower. Among these supply chain the step of collector to wholesaler have the highest post-harvest loss due to weight loss equivalent have been charged to collector by wholesaler and collector to farmer. This loss is the predicted loss rather than the achieved. The second step of loss was during production level once the product is ready to harvest but not preferred by consumer because 5.2% of loss was occurred during different steps of loading and unloading (Table 5).

Table 5: Perceived Post harvest loss of cauliflower in different stages

Step 1.	Farmers level					Total loss (%)
	Nutrient deficit	Wrong handling Practices	Insect pest damage	Riciness	Time and practice	
Production	1		0.2	0.5		1.7
Harvesting					0.5	0.5
Step 2.	Farmers to collector					
Loading and unloading	1.5					1.5
Step 3.	Collector to wholesaler					
Stain due to rubbing and less no of leaves		0.5				0.5
Weight loss	3					3
Step 4a.	Wholesale to retail					
Loading and unloading		1.5				1.5
Step 4b.	wholesale to collector to retail					
Loading and unloading		2				2
Step4c.	Retail-collector-processing unit					
Loading and unloading		.2				.2
Total loss						10.9%

Cauliflower production in the year of 2016 was 550044.8Mt and in the year of 2019 it was 574795Mt. Total post-harvest loss in the year 2019 was 62652.66Mt. Average price of cauliflower was Rs28/Kg and the total value was Rs.1, 75, 42, 74,340 (Table 7).

Table 6: Economic loss due to negligence on post-harvest activities



Source: CBS, 2016 and CBS, 2019

Table 7: Economic value of post-harvest loss in a year

Total loss (Mt)	Average price	Total value
62652.655	Rs28/Kg	Rs.1,75,42,74,340

Minimization of post-harvest loss and impact on status of import of cauliflower

Cauliflower import of 3122.540Mt. with the value of 50,22,87000 was recorded in the year 2018/19 whereas 11.367 with the value of 3,13000 has been export. So there is 3111.17Mt of import and export gap so only by minimizing the 50% post-harvest loss of the total production, the import level will be checked (Table 8).

Table 8: Import export gap

Trade	Mt	Value
Import	3122.540	50,22,87000
Export	11.367	3,13000
Import export gap	3111.17	
Total PH loss-Import	59,541,48	
If PH loss minimized up to only 50% then also we can stop import		

Source: CBS, 2018/2019

Different technology and the practices in wholesale shop

Displaying cauliflower in the market plays key role to make cauliflower fresh by preserving the floret part. Not perforated polythene bag (Figure 1) and iron made structure (Figure 2) were the two different technologies existed in wholesale market.



Figure 1 Non-perforated Polythene bag



Figure 2 Iron made structure

Different technology and the practices in retail shop

Handling practices changed with the scale of shop. There were abundance numbers of small holding retail shop almost 10 shops with in the distance of 1Km (Figure: 3 Kathmandu Tokha). Post-harvest loss was higher in small retail shop in comparison to capacity of more than 50Kg. Uncovered cauliflower with a smaller number of leaves that is 2 to 3 (Figure: 3) automatically reduces the quality of curd. Beside this retail shopkeeper are less aware about the loss because they deal with multi commodity and scaled economy due to quality.



Figure: 3 Cauliflower with 2 to 3 leaves



Figure: 4 Cauliflower display with other commodity

Quantity and quality matters for the processing

Within the different supply chain; actors as collector and dealer of supermarket have the most important role in processing. Due to healthy and smart display practice the cauliflowers left over are recollected by the collectors from supermarkets are processed for pickles. Processed material as pickle, dried cauliflower are available in market but don't have any scientific knowledge and experience.

Chain stores

Smart and clean display in the shop matters the post-harvest loss. Big mart, Bhatbhatini supermarket and department store have the same price with vendor but smart and clean display fulfills the need of consumer. As well no risk of post-harvest loss because the large vendor recollects the cauliflowers if not sold in the market.

Gender perspective

Genders role and identity vary with the resources and the time availability of an individual. Gender based division of labour in vegetable production vary from ward to ward, with in the ethnic group, socio-economic and within and among professions of business partners and the family. In Dhading district not any remarkable issue about the gender was observed but in the case of Banepa social distortion due to installment payment and equal access of money to both man and woman farmer but not the equal ownership.

Both the male and female partners are involved equally in cauliflower production process.

Man have the dominant role in almost all the niche of cauliflower production cycle where the skill is required. However, after the products deliver to the aggregator the payment system is in installment basis due to price determination problem of the day. Inappropriate lending of the money from women's hand to male partner. In Dhading mostly women were associated with women's group and the cooperatives so decision regarding the varietal choice, doses of soil nutrient, price of cauliflower and other inputs are guided by member of the cooperative.

Gender's role in trading

Retail marketing or handling of micro trading is dominated by women whereas; wholesale marketing is done by man.

4. CONCLUSION

Year-round supply of cauliflower was in market and in the time of Mangsir to Falgun the supply side is higher than the demand side. Cauliflower production shows the increasing trend with potentiality of export. Around 10.9% percent loss was perceived since the production to consumers table. 10.9% post-harvest loss depicted the importance of knowledge about the handling practices of cauliflower. Weight loss during storage (The steps from farmers to collector and collector to wholesaler), production level due to carelessness of weather-related indicators (Temperature, rain, cloud and the sunshine) are the major steps of post-harvest loss. Following are the measures to reduce the post-harvest loss of cauliflower. No any loss while grading and packaging because none of the stage reported the grading and packaging practices. Most of the postharvest activities were done by male members. Most of the farmers are only growers and the rest of the postharvest activities were done by traders. Male and female ratio in cauliflower production is almost 50:50. Wholesale market is led by male while females are dominant in small scale retail shop. Very negligible knowledge was found about the processing.

Recommendation

There are different measures to prolong the storage of cauliflower by adjusting or with modified climatic parameter like temperature and humidity it's lacking because there was not any storage structure to modify the required temperature. Not any branding, grading and specific packing technology and material was found specially designed for cauliflower. Not any processing facility and advanced knowledge about the processing was noted out so develop a plan to support to processing plant and the traders. Awareness about the economic and social importance of grading.

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Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Data and materials availability

All data associated with this study are present in the paper.

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